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Implementing tele presence robots in distance work: experiences and effects on work

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Abstract. As companies move toward globalization, companies use distance work to accomplish work more effectively and efficiently. A telepresence robot (TPR) is a mobile remote presence device that allows a two-way communication and interaction between a distance manager and the employees. The objective of the study was to improve the understanding of how distance workers and managers experience the use of TPR in the daily management and in which tasks the TPR is suitable to ensure employee well-being and thus performance. The data collection included three phases – before, during and after the implementation of the TPR, where we conducted 25 semi-structured individual and group interviews, on-site observations of the TPR in use and research notes. The distance manager (user) controlled the TPR from a distant site when using it in the home office. The managers were able to create a sense of proximity and via the camera feature, enable eye-contact, which the managers considered essential and beneficial for assessing the employee's feelings and well-being. The majority of the users had a positive experience regarding the TPR basic functionalities´ utilization. In all three cases the participants, both managers and employees, agreed that the TPR is most useful in planned project meetings. On the other hand, the lack of trust, problems with the technology, privacy issues and intrusive emotions affected the use of the TPR in a negative way in some cases. The TPR was not suitable for meetings where people needed to share physical documents or important meetings, i.e. private talks or decisions meetings.

Keywords: Telepresence robots, Implementation, distance management.

1 Introduction

1.1 Dispersed work and distance management

Over the years, organizational changes in large traditional organizations and the development of new business opportunities across the world have dispersed workplaces and employees [5]. As companies move toward globalization and communication technologies facilitate a quicker pace of change within organizations [6], companies use distance work [1] to accomplish work more effectively and efficiently. Distance work and management can occur at different locations, from home (telework), in satellite offices (intra-organizational work), or at the customers' or clients' locations (interorganizational work) [2, 3].

Distance managers are concerned about the wellbeing of their employees working across distances so that the employees can perform [4]. Therefore, distance managers look for processes and technologies that can support the trusting relationship and create a sense of proximity across distances, which are two key elements of employee wellbeing in distance work [1, 4]. With regard to this, the dialogue is a core activity to ensure well-being, where the managers listen to their employees and acknowledge their situation and job conditions. The primary technologies are emails and real-time communication tools allowing for synchronic communication like Skype, phone, Lync, and if possible, telepresence technologies [7].

1.2 Telepresence Robots (TPRs)

Telepresence technologies, specifically, exist also in mobile versions, termed mobile remote presence (MRP) technologies, where telepresence robots (TPRs) as the Double from Double Robotics is an example of this. The combination of video conference and robotics forms the ground of the invention of telepresence robots (or remote robotic presence). Thus, TPR is a mobile remote presence device that allows a two-way communication and interaction between a distance manager (called user) driving and utilizing the TPR, and a person exposed to the interaction with the TPR (called participant).

TPRs require that two people interact through one robot - the person that controls the robot, which acts as the user, and the person exposed to and interacting with the robot (the double in this case) as part of his/her daily work. Thus, the interaction becomes two-way via the TPR. Consequently, TRPs can improve interaction across distances, however, the use requires considerations for implementation and operations as they involve human-robot interaction (HRI). HRI can be studied from a robotics-centered or human/user-centered perspective.

1.3 Objective

Despite increased attention to the use of robots in work processes, research has yet to uncover the effect of dual/two-way interaction and application of TPRs in daily work and management across distances. With this paper, we contribute to a clearer understanding of the effect on work and employees of applying and interacting across TPRs.

The exploration of the dual interaction, introduction and application of TPR in distance work allows to outline some conclusions, not yet depicted in previous research, on user experiences involved. Moreover, this study enables to discover tasks that are suitable for the TPR usage and to formulate suggestions for new users.

The objective of the study is to improve our understanding of *how distance workers and managers experience the use of TPR in the daily management and in which managerial tasks the TPR is suitable to ensure employee well-being and thus performance*.

1.4 Research design

The study completed early 2018 with a total number of three companies. The paper presents the findings of an exploratory case study of three knowledge intensive companies (KICs), representing software development, engineering consultancies and finance and banking. We used the following criteria to select the cases:

1. Knowledge intensive companies,
2. Located in the surroundings of Copenhagen, to have quicker access to the facilities,
3. The daily manager works from another site than the his/her employees i.e. intra-organizational work,
4. Trial period of the TPR for four weeks as part of daily management,
5. "Open space" office design to allow the independent motion of the TPR.

The study builds on literature on distance management [1, 8], knowledge work [4, 9–12] and human-robot interaction [13, 14]. To investigate how distance workers experience their manager's use of TPR in their daily management and in which managerial tasks the TPR is suitable to ensure employee well-being we did an empirical investigation in knowledge intensive work following general guidelines for conducting qualitative research [15, 16].

1.5 Data collection

We focused the data collection and analysis on the interaction between distance employees and their manager's use of the TPRs with a three-fold purpose: (1) assess positive and negative user experiences (Managers), (2) determine in which situation TPRs are useful, and (3) highlight the employees' personal feelings and emotions when communication via the TPR.

Data collection was structured in three phases – before, during and after the implementation of the TPR. The methods included semi-structured interviews before and after the trial period of the TPR, on-site observations of the TPR in use and research notes to explore the individual experiences of working with a tele-presence robot. The distance manager controlled the TPR from a distant site when using it in the home office. We conducted, eight interviews, three managers (before and after, that was the main user of the TPR) and 17 employees (mainly after), were interviewed across the three cases focusing on the users' experiences and personal emotions involved when working with the robot.

Table 1. Interviews with managers (User)

Company	Before implementation	After
Consultancy	1	1
Bank	1	1
Finance (IT)	1	1

Table 2. Interviews with employees (Participants)

Company	Before implementation	No. of Group-interview (after)	Total no. of participants
Consultancy	0	1	8
Bank	1	1	2
Finance (IT)	0	1	7

To assess positive and negative user experiences, determine in which managerial tasks the TPR is suitable and highlight the personal feelings and emotions involved, we observed the employee tele-presence robot interaction. In total, we observed 20 situations where the TPR was in use. When operating the TPR, the managers worked from home or other branch offices and the latter respondent group worked at the home office. We thus focus on intra-organizational distance work where distance was geography and/or time. Distance work at customers (inter-organizational distance work) is excluded from this study.

To do so, we explored the use and adoption of the TPR technology building from Venkatesh and Davis' Technology Acceptance model (2000) TAM, which focuses on the user's acceptance of the technology to ease technology adoption and thereby performance. Particularly the newest version is used: the TAM3, evolution of TAM2 [17], that embraces new determinants of perceived usefulness and perceived ease of use [18].

1.6 Data analysis

The interviews were transcribed and coded in an open process applying Atlas.ti where the initial codes derived from the research question [19]. The initial codes were: 1) User experiences (distance manages) 2) Situations/tasks applying the TPR 3) Personal emotions regarding work and distance management applying the TPR. An inductive approach [20] was also applied to explore other factors that characterize distance management, which have not already been identified. To organize and synthesize data and develop themes, we applied a template analysis model [21].

2 Findings and analysis

2.1 Distance manager experiences (User)

The cumulative results across the three case studies show that the distance managers, i.e. the user of the TPRs, were able to conduct meetings from a distance and create a sense of proximity, even if not physically there but using the robots. The Double's ability to drive and navigate eased the experience. Moreover, the TPR, via the camera feature, enabled the eye contact, which the user considered essential and beneficial for the well-being and the monitoring of colleague´s feelings. Thus, the majority of the

users had in general a positive experience regarding the TPR basic functionalities´ utilization.

On the other hand, the lack of trust, problems with the technology, privacy issues and intrusive emotions affected the use of the TPR in a negative way in some cases. The users therefore suggested technical improvements of the Double and identified the best-suited situations and tasks. Finally, the managers expressed the importance of involvement all the people interested in the change, trying to integrate actively the TPR into the current working routines and activities.

2.2 Employees experiences (Participants)

The positive employee experiences related to the technical side where the respondents appreciate the technology and the video contact as the manager became present with the TPR as the robot created the ability to see each other and not just listen to a voice. Some employees expressed that it as a positive experience to be able to communicate with both eyes and ears as it gave a live feeling, when the manager could not be on the same site as the employees. Though not physically present, the TPR reminded the employees of the presence of the manager and did not consider it disturbing that he/she moved around. The TPR was silent, facilitated a conversation across a distance and was easy to use.

However, interviewees criticized the audio, the weight and the audio quality (in some instances). Others felt monitored and controlled when the TPR was present (not in use) and the attention it got disturbed the work. Across the three cases, some employees compared the TPR with Skype and questioned the gains of shifting to TPR.

2.3 Situations and suitable tasks

Useful tasks and situations

In all three cases the participants, both managers and employees, agreed that the TPR is most useful in planned project meetings (3:3) (See Table 3). Other tasks and situations in which the TPR was useful was in group meetings and interoffice meetings (even with a questionable distance involved). Only one in three (varied across the cases), found it useful to apply the TPR as a management substitute when working from home, for both interoffice and intra-office meetings, status update, small talk, supervision tours, ideas sharing and brainstorming.

Table 3. Cumulative analysis – useful tasks and situations for TPR

Situation and task	No of cases	Final evaluation
Planned project meetings	3:3	Useful
Big group meetings (>5)	2:3	Useful
Small group meetings (< 5)	2:3	Useful
Interoffice meetings	2:3	Useful
Work from home	2:3	Useful
Status update meetings	2:3	Useful
SCRUM meetings	1:3	Useful

Intra office meeting	1:3	Useful
Small talk	1:3	Useful
Supervision	1:3	Useful
Brainstorming	1:3	Useful

Not useful tasks and situations for TPR

Data shows, that the users only found the TPR unsuited and not useful in four tasks and situations (see Table 4). Managers from all three cases expressed frustrations regarding the TPR however, each respondent stated different tasks as problematic. The TPR was found not useful for meetings in which there was the need of sharing physical documents among people, multiple users were driving the TPR at the same time and for important meetings, as private talks and crucial decisions were taken. Additionally, the TPR was not considered useful when meetings were held outside the firm or in meetings with (potential) new clients.

Table 4. Cumulative analysis – not useful tasks and situations for TPR

Situation and task	No of cases	Final evaluation
Important meeting	1:3	Not useful
Chair/host of a meeting	1:3	Not useful
Share documents	1:3	Not useful
Acquire or keep a client	1:3	Not useful

2.4 Emotions

The analysis shows that the personal emotions and feelings aroused, mainly from the user (manager) side but also in some participants, mainly related to mistrust regarding the TPR. That is foreseeable since the implementation of new technologies requires some adaptation time. Later the users felt confident and found the TPR easy to use when they adopted the new channels of communication. The distance managers appreciated that they could perceive facial expressions and emotions through the camera contact. These aspects led to a renewed feeling of being present in same the place, which they had experienced before with other technologies. The TPR various functionalities also resulted in less travels which relieved some stress among the managers. Among the employees, some felt a bit disturbed by the unusual presence of the TPR, sometimes even controlled (simply by having it there) and did consider the TPR as part of their current practices.

3 Discussion and Conclusion

The data shows that the initial motivation of wanting to use the TPR to improve savings sand reduce expenses due to less travelling has been met. Across the three cases, the managers also considered the current Skype solution already installed and implemented, with the costs and timings related to the implementation of a new technology as the TPR. Finally, the TPR demands extra planning to use it properly. TPR has been found beneficial in those situations in which the people that are present know well each other, with a long-lasting relation and for managerial tasks that are scheduled and familiar for the people involved, possibly recurrent over time. Conversely, the tasks found difficult for a manager are the ones that include clients or people not commonly contacted and placed outside the company. Lastly, sensitive and private speeches are reputed to be non-manageable through the TPR.

3.1 Conclusion

When implementing a new technology, it is interesting to discuss if the problems that occur are related to the maturity of the technology, is a user issue, or perhaps a combination of both but also the gains that the technology provides. Specific characteristics of manager´s experiences affect the introduction and implementation of the TPR in both positive and negative ways.

On the positive side, the cumulative findings of this study show that most users (managers) found that the basic functionalities of the TPR worked satisfactorily. The feeling of being present and the usage of the camera function to see colleague's reactions are unquestionably the most useful ones among the several detected. According to the experiences from the companies usages, there are some specific managerial tasks in which the TPR can be easily used by distance managers, bringing some benefits and easing their daily practices. For example, the TPR relieve some frustration in distance managers due to the fact that some travels can be avoided or decreased (as expected), improving the perception of being actually present. Moreover, the TPR opens new communication channels that are better compared with other solutions used before, since as declared by the users, it provides eye contact considered crucial by managers.

On the other hand, some unexpected problems with the technology happened, including mistrust and privacy issues that could negatively affect the TPR usage. There are tasks (not preventively foreseen), in which it is difficult to use the TPR, provoking additional complications instead of easing the manager´s journey. People are not sure to use the TPR, in situation where they are heavily dependent on the context, the people involved and the environment that can obviously vary from one situation to another. In addition, personal emotions from both the user and the participant side are crucial when implementing the TPR, because they directly affect the user´s behaviours. The TPR brings some negative feelings, for instance, when dealing with a robot and not a human. Across cases, people felt disturbed and in some cases monitored and controlled, simply by having the TPR present there. Altogether, the case study compose a set of suggestions and guidelines, based on the outcome of the data analysis, to be followed when implementing a new technology as the TPR investigated in this work.

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Noter fra IPM Review:

- ~~Måske fjerne speficifikke teknologier~~
- Skal det ende ud med en typology?
- ~~Jakob oplevede at det ikke var interaktionen der var vanskelig men tekologien, resolution var ikke høj nok til at deltageren kunne se noget på skærmen.~~
- ~~Ændre titel uden – og : – og husk HF & ERgonomics~~
- Der er en lang sætning i 2 afsnit
- Mere HF&E i Purpose
- HF fokus i data collection
- Hvilken rolle spiller TAM i motivationen?
- Results – husk analyseret ved HF & E.
- Need to see more theory
- Consider: What can TPRs improve in the DI work and dima?
- *Improvements* – which?
- Begins with dialogue – ends with interaction – consider which.
- Consider – what is it that TPR can improve?
- Clarify: why would people use it? (drivers)
- What are the output/impact that convince them to use it?
- How should it be implemented in the future?